VOYAGER II

OPERATOR'S MANUAL

FLIR

©FLIR Systems, Inc., 2009. All rights reserved worldwide. No parts of this manual, in whole or in part, may be copied, photocopied, translated, or transmitted to any electronic medium or machine readable form without the prior written permission of FLIR Systems, Inc.

Names and marks appearing on the products herein are either registered trademarks or trademarks of FLIR Systems, Inc. and/or its subsidiaries. All other trademarks, trade names, or company names referenced herein are used for identification only and are the property of their respective owners.

This product is protected by patents, design patents, patents pending, or design patents pending.

The Voyager imaging system is controlled by US export laws. There are special versions of this system that are approved for international distribution. Please contact FLIR Systems if you have any questions.

FLIR Systems, Inc.
70 Castilian Drive
Goleta, CA 93117
Phone: +1.888.747.FLIR (+1.888.747.3547)
www.flir.com

Document Number: 432-0002-00-10, Rev 110

Document History

Revision	Date	Comment
100	Feb 2008	Initial Release
110	Mar 2009	Includes NMEA functions, expanded TOC and other minor changes

This document is controlled to FLIR Technology Level 1. The information contained in this document pertains to a dual use product controlled for export by the Export Administration Regulations (EAR). FLIR trade secrets contained herein are subject to disclosure restrictions as a matter of law. Diversion contrary to US law is prohibited. US Department of Commerce authorization is not required prior to export or transfer to foreign persons or parties unless otherwise prohibited.

TABLE OF CONTENTS

CAUTIONS 8

OPERATION 9

System Description 10

Joystick Control Unit (JCU) 11

Voyager JCU Controls 12

GETTING STARTED 17

MENUS 21

Icon Display 24

Maintenance Menu 25

Joystick Mode 26

Park 26

NMEA INTERFACE 27

NMEA Interface Functions 29

NMEA Interface Setup Menu 29

Radar Cursor Tracking 30

Slew to Waypoint 30

Radar Tracking 31

Message Priority 32

Dwell Time 32

Mount Height 32

WEBCAM FEATURE 33

Before You Begin 34

Configuration Steps 34

Access the Webcam Locally 36

CAMERA CONTROL 38

Image Mode Control 38

Image Contrast 38

Black/White Hot 39

Field of View (FOV) Control 39

Focus Control 39

Remote Access 40

IP Configuration 40

WEB BROWSER CONFIGURATION 44

TROUBLESHOOTING & CLEANING 47

FUNDAMENTALS OF INFRARED 49

Introduction to Infrared Technology 50

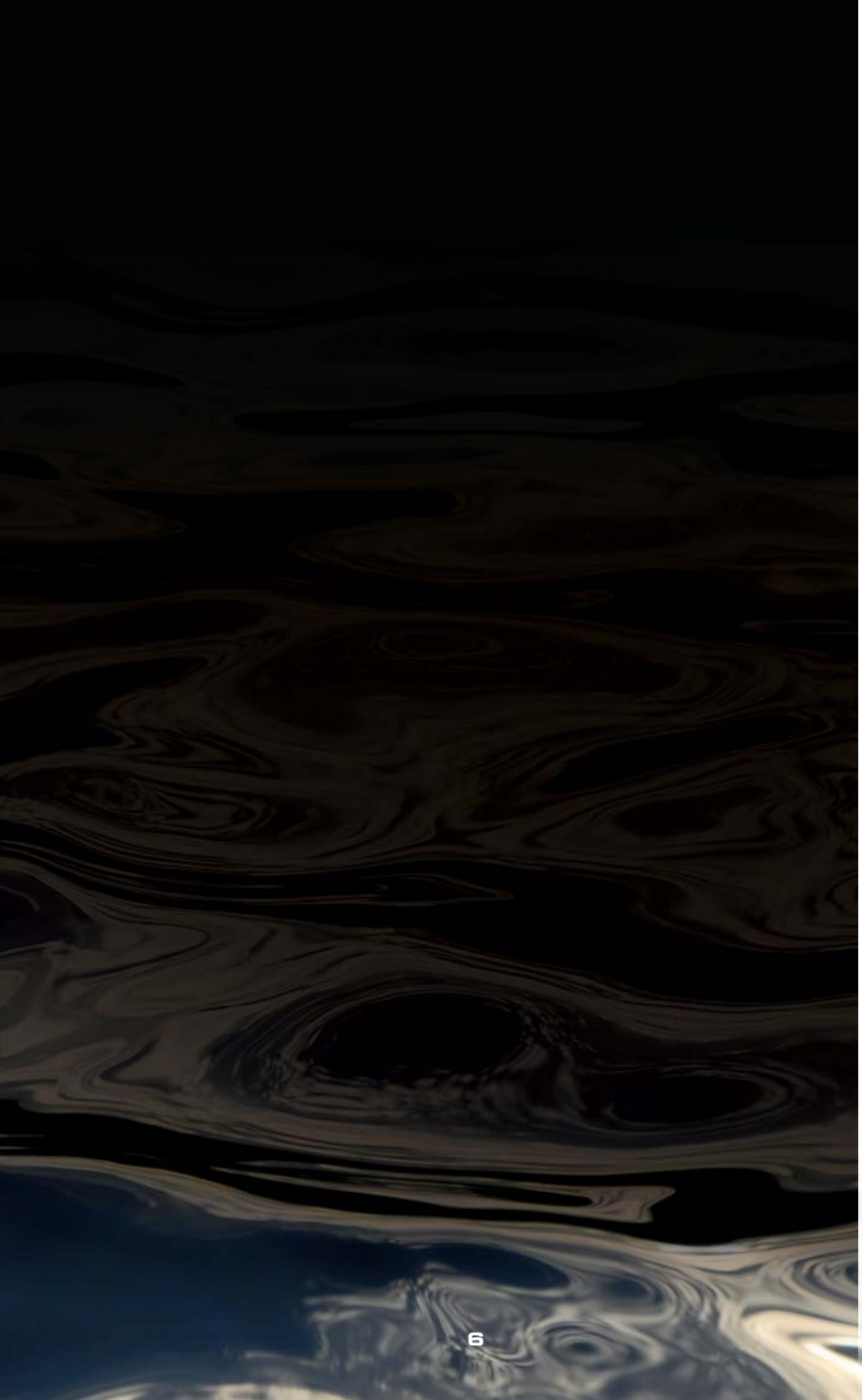
More about Infrared 52

APPENDIX 57

Parts and Accessories 58

System Overview 59

List of Icons Inside back cover



CONGRATULATIONS ON BUYING THE VOYAGER II

Welcome to the pioneering world of maritime thermal imaging! The Voyager II is a state-of-the-art thermal imager that lets you see at night, through smoke and haze, without any lighting at all. FLIR has been building thermal imagers for decades, and we are confident that you will see why FLIR is the #1 name in infrared around the world.

Thermal imaging technology has been a staple of military operations for decades, but FLIR has just recently made it available to the public, and only to a select few at that! By purchasing a FLIR thermal imager, you have established yourself as a mariner on the leading edge of technological advancement. Remember to register the Voyager by filling out the Registration card.

You will find that the Voyager is simple to use; it includes a Camera Body to install on the deckhouse or mast location of your choice, a Bulkhead Box for installation below deck, and a Joystick Control Unit (JCU) for installation at the primary pilot station. Voyager will support up to 4 control stations onboard and the video can be displayed on virtually any multi-function display or video monitor.

Voyager uses two thermal imagers: one with a wide field-of-view (FOV) for navigating and overall situational awareness, and another longer-range imager for hazard and vessel identification. Both cameras provide clear imagery regardless of lighting conditions.

CAUTIONS

In the Voyager Operator's Manual, **CAUTION** notices indicate a potential hazard, which, if not avoided, may damage you, someone else, or the Voyager. For safety, and to achieve the highest levels of performance from the Voyager, always follow these Cautions when handling and operating the Voyager camera system.

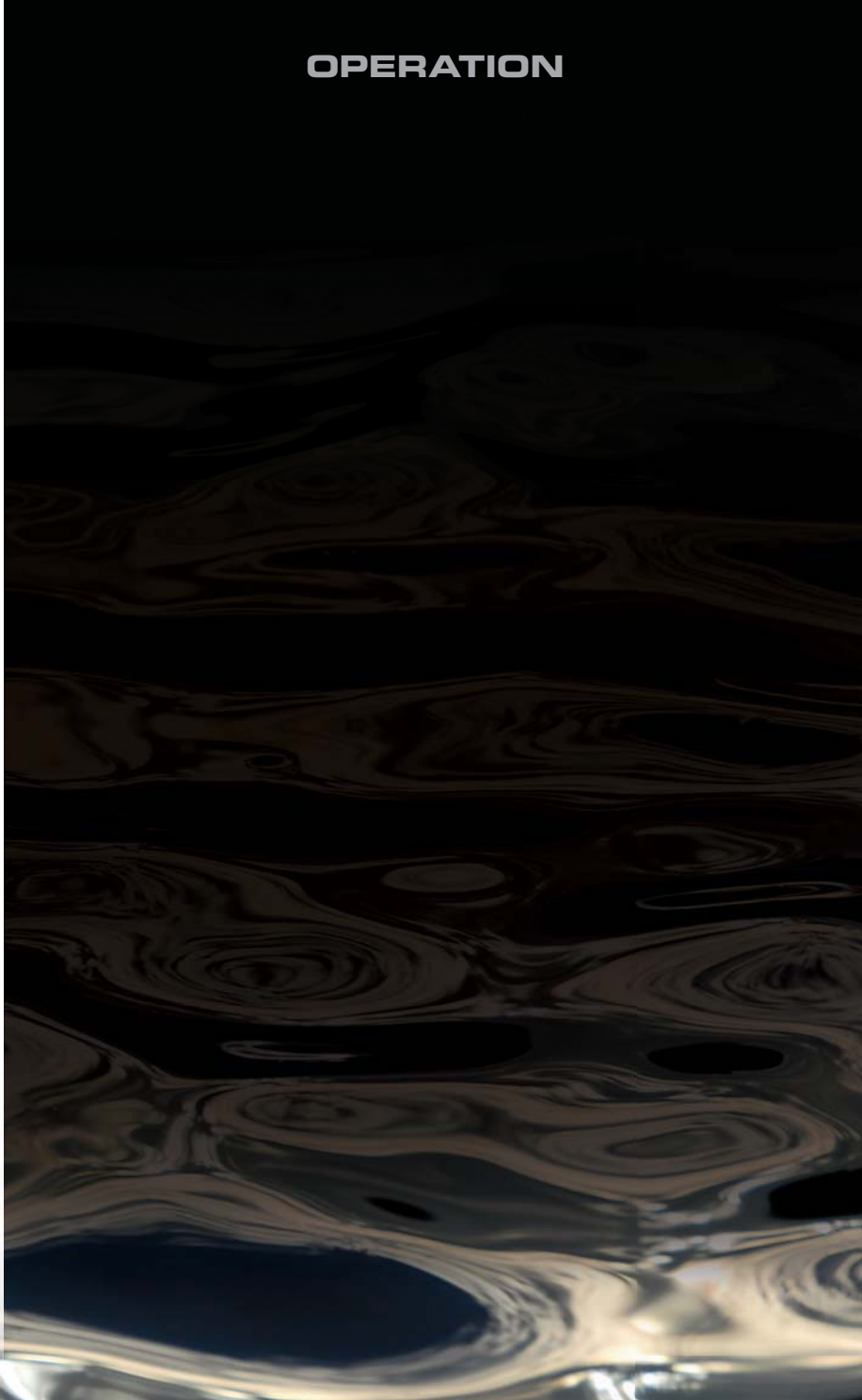
CAUTION!

Failure to follow the caution may result in damage to the Voyager.

CAUTION!

- Do not use the Voyager imaging system as the primary navigation system. Use it in conjunction with other navigation aids and a primary manual navigation system.
- Do not open the Voyager camera body for any reason. Disassembly of the camera (including removal of the cover) can cause permanent damage and will void the warranty.
- Be careful not to leave fingerprints on the Voyager's infrared camera optics. They are treated with a special coating that can be permanently damaged by the oils in your skin. Also, they are delicate and can be damaged with improper cleaning.
- The Voyager runs off of 24 VDC. Operating the camera outside of the specified input voltage range or the specified operating temperature range can cause permanent damage.
- Do not use the thermal imager to look at high-intensity radiation sources like the sun, lasers, arc welders, etc., as prolonged exposure can damage the imagers.
- The Voyager is designed to withstand the shocks and vibrations commonly encountered in the normal maritime environment. Don't expose the camera to excessive impacts.
- Don't paint the Voyager, as this may void the warranty.

OPERATION



SYSTEM DESCRIPTION

Voyager is a stabilized maritime thermal and visible-light camera system for use on nearly any kind of vessel. It uses two thermal imagers to provide wide-angle and telephoto zoom images, instead of one imager with a long telescope.

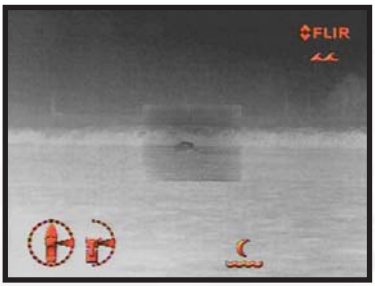
The Voyager consists of three main components: the Camera Body, Joystick Control Unit (JCU), and Bulkhead Box. Each of these components is designed for years of rugged, trouble-free use.

The Voyager Camera Body

The Camera Body's pan/tilt mechanism allows the operator to look 360° in azimuth, and +/- 90° in elevation. The Camera Body houses all three of Voyager's imaging sensors: wide-angle infrared, long-range infrared, and zoom color daylight/low-light camera.

Each of the infrared cameras uses an uncooled vanadium oxide (VOx) detector sensitive to long-wave infrared (LWIR) energy. The wide-angle camera uses a 35mm lens, and the long-range camera uses a 140mm lens.

In its default setting, Voyager will zoom digitally from the wide FOV camera to the narrow FOV camera. At the point when the Wide FOV reaches 2X zoom, the system switches seamlessly over to the narrow FOV camera and zooms digitally to its maximum magnification.



The Voyager's Camera Body is sealed at the factory against atmospheric humidity, suspended particulates and other contaminates. It is important that you not open the Camera Body for any reason, as it will compromise this seal and possibly damage the unit. Opening the Camera Body will void the manufacturer's warranty.

Bulkhead Box

The Bulkhead Box is the central hub for all other Voyager system components. It accepts vessel power in (24VDC), and exports it to the JCU and Camera Body. The Bulkhead Box also passes command signals from the JCU to the Camera Body, and exports up to four video signals for viewing around the ship.

Cables

The Camera Cable connects Voyager's Camera Body to the Bulkhead Box. This cable will be either 50' or 100' long, depending on which length you ordered. It relays power and control commands between the Camera Body and the JCU, and outputs standard RS-170 video. This cable connects to the back of the Camera Body base with a circular connector. It is important not to bend this cable too tightly.

Detailed instructions for connecting the cable to the Bulkhead Breakout Box are included in the Installation Guide.

JOYSTICK CONTROL UNIT (JCU)

The JCU is your primary method of control for the Voyager. It allows you to point the Voyager, zoom the cameras in and out, switch between infrared and visible-light cameras, focus, and adjust the Voyager image quality, among other functions. In conjunction with the Joystick, the Voyager provides Accu-Point, a complete set of on-screen symbology, so you can see where the camera is pointed at all times

Refer to the List of Icons section for a description of the symbols that appear on the screen, depending on the camera settings and the JCU buttons that have been pushed..

VOYAGER JCU CONTROLS

Each of the JCU's functions, and their corresponding on-screen symbology, are described in this section.

Power – Press this button to turn the system On and Off. When turning the system On, two splash screens will display. When the thermal image is displayed along with the pan and tilt symbols the Voyager is ready to use. It will take approximately 40 seconds before the system is completely active; a "Loading, Please Wait..." message will display until the Voyager is ready for use. When turning Voyager Off, drive the Camera Body to the Park position with the Joystick (described below), and press the Power button to deactivate the system.

The Voyager II is in the Park position when its optics are pointed straight down. This position protects the cameras from damage when not in use. Park the Voyager before turning the Voyager Off.

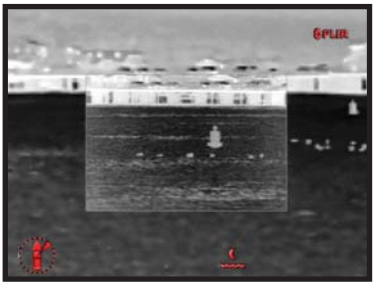
Setup – Press this button to access the Setup menus. (See Menu section for full explanation.)

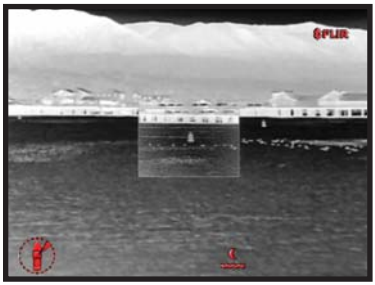
VIS/IR – Press this button to switch between IR and visible-light cameras and back, as desired.

Dim – The JCU controls are backlit to make them easier to see at night. This button controls the brightness of the JCU backlighting, so you can adjust it for your comfort. Press this button to cycle through the four different settings or levels of brightness.

Joystick – Use the Joystick to pivot the Voyager's Camera Body left and right, and tilt it up and down. It is intuitive to use – push the Joystick to the left, and the Voyager will pivot left, push the Joystick to the right and the Voyager will pivot to the right. Push the Joystick forward and the camera will tilt down, pull it back and the camera will tilt up.

Zoom – Twist the knob on the Joystick to zoom in and out with the active sensor. Twist the knob to the right to zoom in, and to the left to zoom out. Thermal and visible-light imagers zoom together, so that when the operator changes from one imager to the other the same FOV is displayed.





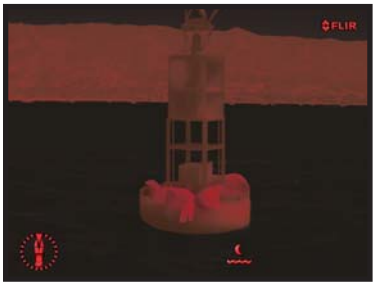
Home – The Home position is a known preset position - usually straight ahead and level with the horizon – which operators can use as a reference. To set the Home position, use the Joystick to point the camera's line of sight to the position you want to set as "Home." Press and hold the HOME button for 3 seconds; the Home symbol will flash when the new Home position is set. When you want to drive the camera to this Home position, press and release the HOME button. When you push the HOME button, this icon will appear on the screen briefly.

Home Icon

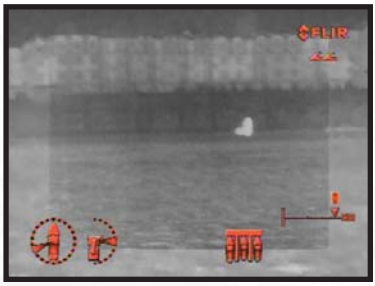
Stab – Pressing this button cycles the 2-axis gyro-stabilization on and off.

Point – The Point command turns off the Voyager's pan stabilization. This can be helpful when you want Voyager to stay pointing in the same position relative to the vessel in a turn.

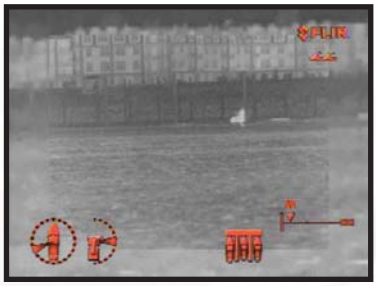
Night – Voyager's infrared imagery is normally black and red video. The NIGHT control toggles the IR imagery from black and red to black and white. Two rainbow color palettes are also available via the Setup menu.



Focus – The Wide FOV thermal imager has a fixed focus; the operator can't adjust it. If the operator tries to adjust the Wide imager's focus, the Focus symbology will flash. The Autofocus (AF) and Manual focus (the IN and OUT buttons) control only the Narrow FOV thermal imager. Use the Manual Focus controls for coarse focus adjustment and press the AF button for fine focus adjustments of the thermal image. The visible-light camera uses a continuous autofocus and its focus cannot be adjusted manually.



Before Autofocus



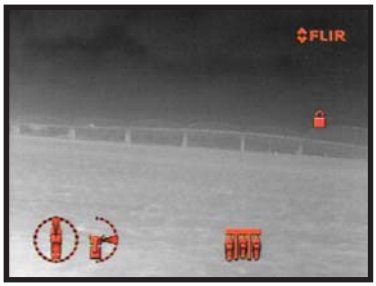
After Autofocus

For best results it is suggested you use the manual focus first when trying to look at an image, and then move to the auto focus mode. This will speed up the focus process. Please be aware that sea conditions may affect Voyager's auto focus ability to lock on a target.

Scene – Voyager has four available automatic gain control (AGC) settings: Day Running, Night Running, Night Docking and Man Overboard (shown below).

Night Running

Day Running



Night Docking

Man Overboard

Pressing this button toggles between these four presets. The infrared cameras in Voyager automatically adjust to the scenes they are viewing to provide you with the optimal image quality. However, you may want to view different areas of the temperature spectrum, or prefer an image that has more or less contrast than that provided. Toggling between these four presets will change the image gain and level settings used as a baseline. Which setting to use comes down to personal preference – if you like the way the Man Overboard setting looks, even though you are running on open water during the daytime, use it. .

GETTING STARTED

During installation, the Voyager was most likely isolated from vessel power with a customer-supplied switch or circuit breaker, so be sure it is turned on. Also turn on the display and select the Voyager as the video source for the display. Most multi-function displays (MFDs) allow the user to select from a number of available inputs.

Press the Power button on the JCU to turn the Voyager on. From there, use the controls on the Joystick Control Unit (JCU) to operate and configure the Voyager. If the Voyager is operated with engines off, be aware that this may drain power from the batteries, unless connected to shore power and equipped with a suitable battery tender.

The Voyager will go through its start-up routine – two splash screens will display for a few seconds, the IR wide FOV will display, and when the icons are displayed, the system is ready to go (see images below). The Voyager starts up in red-hot mode. This is because many users will be turning the system on when there is little or no light available, and is an effort to preserve the operator's night vision. If the white-hot display mode is preferred (as shown in the bottom picture), simply press the NIGHT button on the JCU.

Move the Joystick to the left and right to pan the camera body left and right, and see how the image responds on the monitor. The Joystick is pressure-sensitive; the farther you deflect it from center, the faster the camera will move. With a little practice, it won't take long before you will be able to follow moving objects in the air and on the water.

After you are familiar with how to make the camera point at what you want to see, take a look at the infrared image itself. Voyager's thermal imagers don't make pictures from light like the visible-light camera does; it senses differences in temperature and makes images based on those differences. When Voyager is in white-hot polarity, the warm things in the scene will display as white, or lighter shades of grey, and cold objects will display as black or darker shades of gray. (When you configure the Voyager for black-hot polarity, this will be reversed.)

As you use the Voyager during daylight and nighttime, you will notice differences in the picture quality – this is normal. Objects absorb heat energy from the sun during the day, and give off (radiate) this energy at night, so thermal contrast – and therefore how things will appear to the Voyager – will change based on the time of day and the weather and so on.

The Voyager automatically adjusts to these changing scene conditions to try and give you the best possible picture. The camera contains four preset conditions that might provide better imagery in certain conditions: Night Running, Day Running, Man Overboard, and Night Docking. While these names indicate their intended use, varying environmental conditions might make another setting preferable; night running while in a harbor, for instance. Experiment with the different settings, and find out for yourself which setting works best in different conditions. Four images showing the changes apparent in each setting are shown below.

Night Running

Day Running

Night Docking

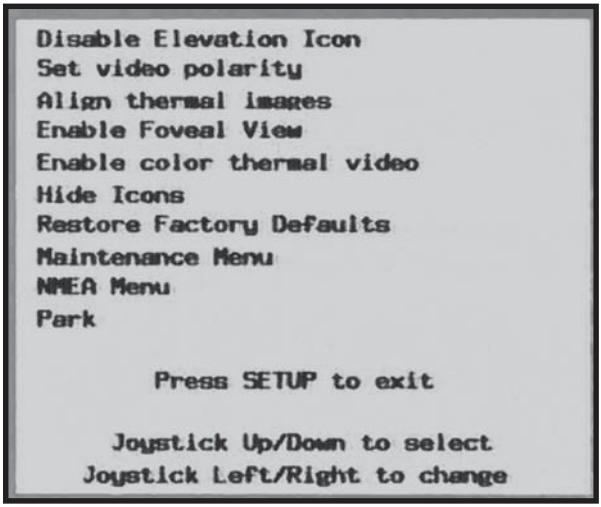
Man Overboard

As you experiment with the Voyager, you will see the world in a different light. Consider every object you view in terms of how it will look "thermally" as opposed to how it looks to your eye. Right after sunset, objects warmed by the sun will appear warmest. Early in the morning, many of these objects will appear cooler than their surroundings, so be sure to look for subtle differences in the scene, as opposed to just hot targets. If you have any questions about the operation of the Voyager, or you would like to provide feedback on the product, please feel free to call us at 1.888.747.FLIR in the United States.

MENUS

MENUS

Voyager's menus allow the operator to customize certain system features. Pressing the SETUP button will activate the Voyager's menu structure.



The Voyager II is continually evolving as FLIR incorporates product improvements, so the menus you see may be slightly different from the ones shown here. If you have any questions, call an Applications Expert at 1.888.747.FLIR.

To navigate the menus, use the Joystick to move the cursor up and down from one selection to the next. To activate a selection, move the Joystick left or right. Once you are satisfied with your changes, press the SETUP button to exit the menus. Each of the menu items are explained on the next page.

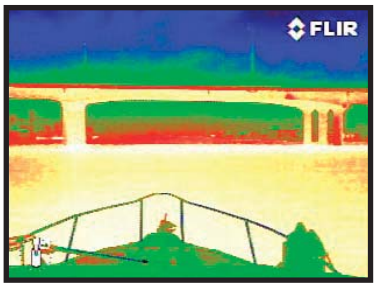
Disable (Enable) Elevation Icon – Selecting this item toggles the elevation icon on and off. Some operators prefer an image less cluttered with symbology, so they turn this icon off. When the elevation icon is disabled, the menu item changes to "**Enable Elevation Icon**". When the icon is enabled, the menu item is "**Disable Elevation Icon**".

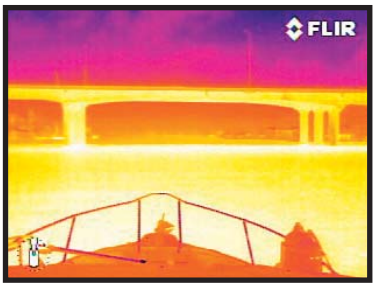
Set Video Polarity – Selecting this item will toggle the infrared imagery from white-hot (or red-hot, if the NIGHT setting is active) to black-hot. The difference between white-hot and black-hot is shown below; white-hot is on the left and black-hot on the right. The use of white-hot or black-hot display mode is strictly a personal preference; experiment with the different settings in different conditions and see which is preferred.

Align Thermal Images – If the operator has selected to leave the Foveal View (picture-in-picture) active, the thermal images may require a small amount of alignment to counteract parallax. Select this item and use the Joystick to steer the inner image around until it is aligned with the outer image.

Enable (Disable) Foveal View – Operators can view Voyager's two thermal imagers separately – with steps of electronic zoom providing transition from one to the other – or overlaid, with the Narrow FOV image nested within the Wide FOV image. This nested image presentation is a "Foveal" view, and lets the operator zoom from the Wide FOV to the Narrow without losing image resolution. Activating this menu selection toggles Foveal view on and off. When the Foveal view is disabled, the menu item changes to "**Enable Foveal View**". When it is enabled, the menu item changes to "**Disable Foveal View**".

Enable (Disable) Color Thermal Video – Some people prefer to look at the thermal images in color instead of grayscale. Enabling this menu item will activate two color palettes, called "rainbow" and "fusion," and change the function of the JCU's NIGHT button to cycle through all four settings: grayscale, red, rainbow and fusion, instead of just two settings. Examples of the color thermal video options are shown on the next page.





Icon Display

From the main menu, it is possible to control the display of icons on the screen by toggling through three setting: Hide Icons, Show Icons, and Display Minimal Icons. The default setting is Display Minimal Icons.

Hide Icons – Selecting this menu item will turn off the on-screen icons except when their corresponding controls are actively in use.

Display Minimal Icons – When the Minimal Icon mode is selected, the azimuth icon and the stabilization icons are displayed continuously on screen. Home, Scene, Zoom, Wide FOV and Narrow FOV icons will display on screen for 3 seconds only before disappearing. Elevation is still an optional icon, selectable from the Setup Menu.

Azimuth Icon

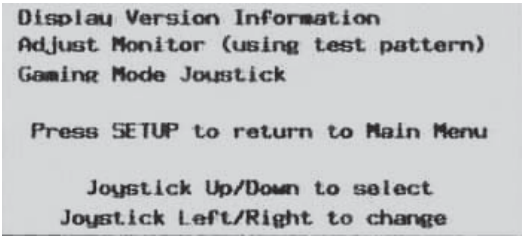
Stabilization Icon

Show Icons - Selecting this menu item will turn on all the on-screen icons at all times.

Restore Factory Defaults – Select this item to restore the Voyager II to its factory default settings.

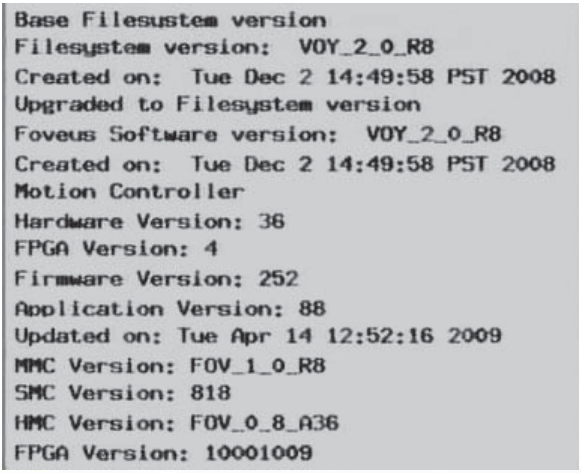
MAINTENANCE MENU

The Maintenance Menu contains the following functions.



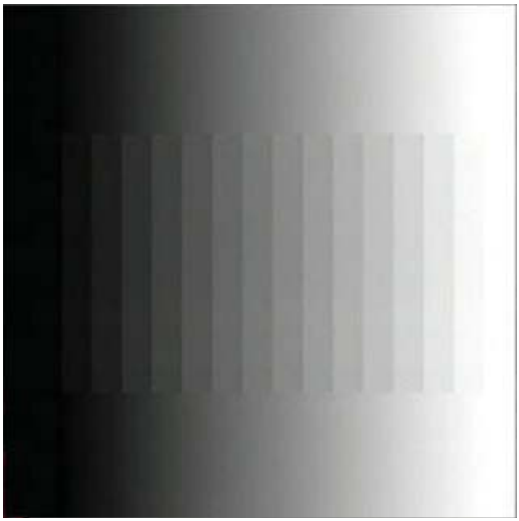
Display Version Information

The Display Version Information function will display the software version information for the Voyager II camera. If you are having any problems with the camera, it will be useful to have this information available when contacting FLIR technical support. An example of the display is shown below.



Adjust Monitor (using test pattern)

Quite often the video from the Voyager II camera can be optimized by adjusting the monitor that is being used to show the video. The Adjust Monitor function is useful for setting up the monitor to give the best detail and contrast. An example of the test pattern is shown on the next page.



When the test pattern is displayed, the monitor brightness and contrast, can be adjusted to give the best image.

Joystick Mode – The joystick can be used in either "airplane" or "gaming" mode. The choice of which mode to use is a matter of personal preference. Chances are, one mode will feel more natural than the other.

1. **Airplane Mode:** moving the joystick forward causes the camera to move down
2. **Gaming Mode:** moving the joystick forward causes the camera to move up

NMEA Menu - The NMEA Menu and its individual functions are described separately in the following section of the manual.

Park - When Park is selected, the stabilization mode is disabled and the camera returns to its Park position, looking forward and down (90^0). The Park function is accessible from the setup menu. While in Park position the Park icon displays on the video screen.

Touching the joystick or any of the buttons on the Joystick Control Unit will return the camera to its previous state (before going into Park)

NMEA INTERFACE

This section describes the set of NMEA Interface Functions supported on the Voyager II. The configuration and use of these features is described in this manual. For information regarding installation of the Voyager II NMEA Interface Card, please refer to the Voyager Installation Guide.

NMEA INTERFACE FUNCTIONS

The NMEA interface allows the Voyager II to communicate with radar, GPS or other devices using the National Marine Electronics Association (NMEA) 0183 Protocol. NMEA 0183 (or NMEA for short) is a combined electrical and data specification for communication between marine electronic devices. Additional information regarding the protocol can be found on the NMEA web site: http://www.nmea.org/pub/0183/.

The NMEA protocol allows the camera to automatically point toward vessels and other objects that show up on the display and to track their movement. The Voyager connects to the other equipment via a serial cable. The Voyager has three NMEA modes of operation:

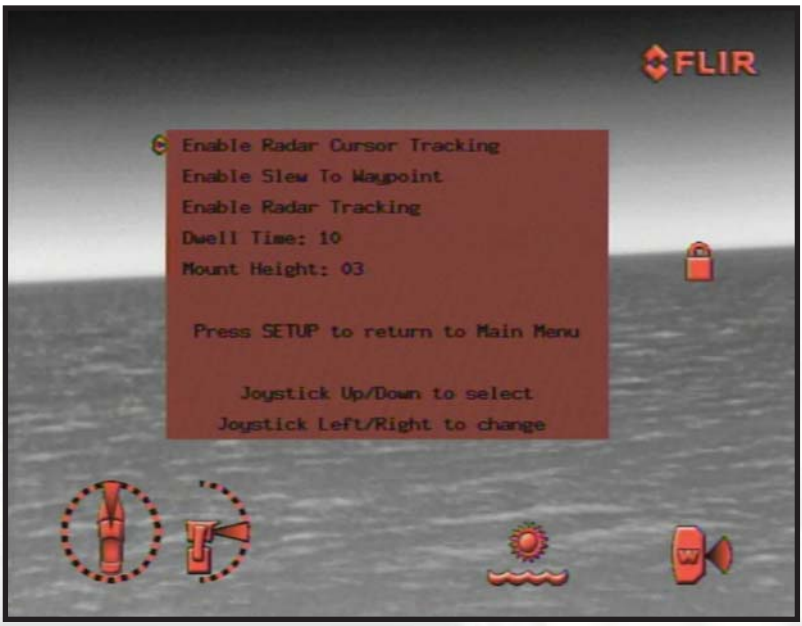
- **Radar Cursor Tracking** - This function is implemented using the NMEA Radar System Data (RSD) sentence format
- **Slew to Waypoint** - Uses the NMEA Bearing and Distance to Waypoint, Great Circle (BWC) sentence format
- **Radar Tracking** - Uses the NMEA Tracked Target Message (TTM) sentence format

These functions are configured with the NMEA Interface Setup Menu. The menus and configuration choices are described below.

NMEA Interface Setup Menu

The NMEA menu is accessed from the Voyager II setup menu. To access the main setup menu, push the Setup button on the Joystick Control Unit (JCU). Then use the joystick to toggle down to the NMEA Menu.

The NMEA menu has the following options:



By default the three possible NMEA modes of operation are disabled. The NMEA menu includes the following choices, which are described in more detail below:

Enable Radar Cursor Tracking

Enable Slew to Waypoint

Enable Radar Tracking

When one of the modes is selected, that menu item changes from "Enable" to "Disable". The NMEA menu allows the Voyager II user to enable more than one NMEA mode at a time (refer to the Message Priority section below for more information on how the different modes interoperate).

Radar Cursor Tracking – With this function enabled you can control the camera by using the cursor on your radar display screen to highlight a target. The camera will track (point toward) whatever target is selected by the cursor. Moving the cursor to a different target will move the camera to the new target (see note below). The Voyager II will continue to follow the cursor until this function is disabled from the main menu. This function is implemented with NMEA RSD messages. When the camera is in the Radar Cursor Tracking mode, the following icon is continuously displayed:

NOTE: Please keep in mind that the Voyager II will point toward the cursor position for the dwell time period (a minimum of 10 seconds). If the cursor is moved during that time, the Voyager II will not move immediately to the new position. It will ignore all other RSD messages (produced when the cursor is moved to another position) until the dwell time expires. Then it will respond to the next RSD message received.

Slew to Waypoint – With this option enabled, the camera will slew (move) to a pre-selected waypoint when that waypoint gets to within approximately a 3 mile (5km) range, based on waypoint location information from the NMEA BWC messages.

For example, while en route the operator could designate a buoy, an island or any other desired landmark as a navigation waypoint and the Voyager II will point toward it automatically when in range. The Voyager II will remain on the target for the specified dwell time. If an additional BWC message is received, the Voyager II

will point to the newer BWC heading for an additional dwell time period. When the camera is in the Slew to Waypoint mode, this icon is continuously displayed:

Radar Tracking – When Radar Tracking is enabled, the camera will track selected radar targets using data from NMEA Target Tracking Message (TTM) information provided by the radar unit.

The user can select up to 100 targets to be tracked by Voyager II (refer to the radar or GPS documentation on how to designate a target). Once one or more targets are selected, the Voyager II will point toward each target sequentially, and track the target using position data that is sent from the radar unit.

The camera points at each target for a pre-set amount of dwell time (10 seconds by default) before moving on to the next target. The time spent on each target can be changed by selecting the menu function Dwell Time and using the joystick to toggle through the available presets. The default value is 10 seconds. The Dwell Time includes the transition time from one target to the next.

> **NOTE:** Due to the way radar operates, it is possible to lose a target momentarily. To ensure that the tracking process continues after the momentary loss of a target, the TTM function maintains the last known position of the target in its queue for 60 seconds after receiving the last valid message. After the 60 seconds has lapsed, that target is removed from the queue.

Once the Voyager II begins to sequentially track the selected target(s), if desired the user can override the automatic scan by using the joystick to point the camera in a different direction. Once the user releases the joystick, the camera will return to tracking its targets 10 seconds after the last JCU input (buttons or joystick).

When the camera is in the Radar Tracking mode, the icon shown below is continuously displayed:

The ability of the Voyager II to accurately track a target depends on the quality of the data sent from the radar unit. The ability of the radar to effectively track a target is influenced by several factors, such as the make and model of the radar unit, the radar update rate, the relative angular rate of the target, the angular rate of the boat heading and the velocity of target being tracked.

NOTE: It is important to enter the accurate mounting height of the camera above the water line to ensure the unit's pointing accuracy for close-in targets.

While the Voyager can track a large number of targets, it is important to understand that in practical terms the number of targets is linked to the Dwell Time. Since the Voyager looks at each target for a minimum of 10 seconds before moving on to the next target, it is possible to set up so many targets such that it will take too long to cycle through all of them for the information to be of any use to the operator.

Message Priority – In the case where you might have a need to enable more than one NMEA feature at a time, please keep in mind there is a set priority to the order in which the Voyager II responds to the different NMEA messages. The priority order is:

1. **JCU input (joystick or buttons)**
2. **Radar Cursor Tracking (RSD)**
3. **Slew to Waypoint (BWC)**
4. **Radar Tracking (TTM)**

For example, if the unit is "listening" to BWC or TTM messages and looking at a particular target, and it receives a RSD message, the Voyager will wait until the end of the dwell time and then move on to the RSD message, ignoring all other input.

Dwell Time – Dwell Time is the time spent on each tracked target. The default value is 10 seconds but you can change it by toggling through the different time options, with a possible range of 10 to 60 seconds

Mount Height – Mount Height refers to the physical height of the camera above the waterline, in meters. This is important because this distance is used for target triangulation and incorrect values will affect the camera's tracking performance.

WEBCAM FEATURE

WEBCAM

It is possible to use Voyager II as a Webcam, allowing you to keep an eye on your vessel from anywhere in the world using an Internet connection. This section describes the IP interface that allows monitoring and control of the Voyager II from remote locations.

BEFORE YOU BEGIN

Using the webcam feature from a remote location requires an Internet connection with a static IP address, or at least an IP address that is known. If the IP address is not static, then every time it changes the webcam feature will need to be reconfigured.

The webcam capability may require a significant amount of configuration of network equipment that is completely independent of the Voyager II camera. Getting it set up and working may require a level of familiarity with managing IP networks that is beyond the skill set of many people. Prior to configuring the webcam feature, make sure you know how to manage and configure the other equipment in the network (for example, whatever cable, DSL or wireless modem/router that is used to connect to the Internet). FLIR technical support can only provide limited support in this regard.

CONFIGURATION STEPS

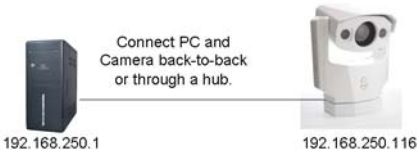
Configuring the Voyager II webcam feature involves the following steps:

1. Connect the Voyager II to a PC and verify IP connectivity
2. If needed, configure the PC web browser to allow installation of the ActiveX component (VLC video player)
3. Access and use the webcam feature locally with the PC
4. Change the Voyager IP address to match the local network on the vessel
5. Configure the Voyager to allow the video to be streamed to an external IP address
6. Test the webcam feature remotely over the Internet

IP CONFIGURATION

The IP address for the Voyager II must be statically configured; it will not obtain an address off the network automatically with DHCP. In order to set the IP address on the camera, it will be necessary to temporarily set up a PC with an IP address on the same network as the Voyager II default IP address.

For example, configure the PC to have an IP address of 192.168.250.1. Then connect the PC and the Voyager II to the same network, or even back-to-back with a cross-over Ethernet cable.



If the network makes use of Network Address Translation (NAT) and port forwarding and/or a firewall, the webcam feature requires that certain ports are opened up to allow access to the camera control and to allow for video streaming. In particular, the following ports are used by default:

Port	Protocol	Comment
TCP Port 80	•HTTP	Web browser access
TCP Port 8080	•HTTP	webcam
TCP Port 554	•RTP	Video streaming

In most installations, the IP address for the Voyager II will be changed from the default address (192.168.250.116) to a different IP address that is within the address space of the existing IP network on the vessel. For example, there may already be devices such as IP cameras, PCs, and routers that are attached to a local area network (LAN). In this manual, we will use the 192.168.1.0/24[1] network as an example for the existing network, and the Voyager will be added to that network.

The IP address for the Voyager II will be modified using a web browser such as Internet Explorer. After the Voyager is powered on, point the web browser of the PC to the default IP address by typing "192.168.250.116" in the location field.

1 The 192.168.250.0/24 designation of the network is known as CIDR notation; it indicates the range of network addresses that use 192.168.250 in the first three octets with a netmask of 24 bits (255.255.255.0).

The web browser will display a picture of the Voyager (the label at the top will indicate PTZ35x140) as shown below.

When this screen appears, the PC is successfully connected to the camera over the IP network. We will return to this login page later in order to make configuration changes to the camera. First however we will test the webcam with the existing default configuration.

ACCESS THE WEBCAM LOCALLY

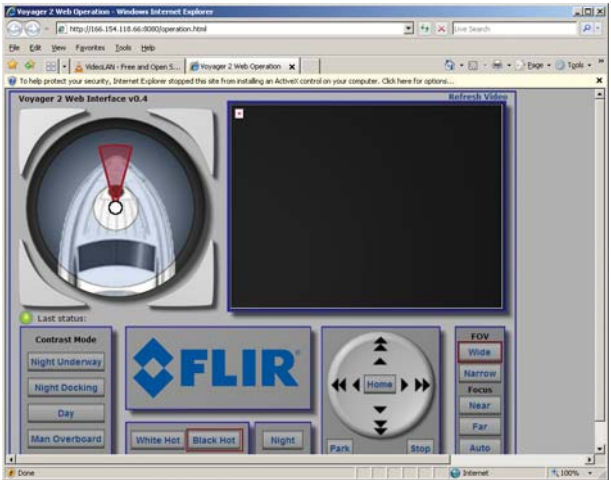
Prior to changing the IP address of the Voyager II, at this point it may be wise to bench test the webcam feature using the local network. The webcam feature is also accessed by using a web browser. The instructions that follow describe how to use the webcam with the Microsoft Internet Explorer browser.

Important: Please refer to the Web Browser Configuration section for information on how to configure the security settings in Internet Explorer and on how to use other browsers.

In the web browser, connect to the following URL (the port number 8080 is required): http://192.168.250.116:8080/operation.html

The first time you connect to the webcam, the following screen will appear. Note the IE Security notice at the top of the screen indicating an attempt to install an ActiveX control. This is the VLC video player that is needed to stream video from the camera. You will be prompted to

install the VLC Player[2] and the Voyager camera will download the ActiveX software to the computer .



Right click on the warning, and install the ActiveX control.

It may take a moment for the video to start streaming. Confirm that video is streamed to the monitor and it is possible to control the camera using the pan/tilt controls and so on. For example, switch between Black Hot and White Hot.

Additional information on how to use the Webcam interface is provide in the following section entitled **Camera Control**. Once operation of the camera has been confirmed, the camera can be configured to allow webcam control remotely over the Internet.

Note: the camera streams video from either thermal camera (wide or narrow field of view). It is not possible to stream the daylight video or the combined wide and narrow thermal video.

2 Please note that currently the Voyager II only supports the VLC Player v. 0.8.6.f

CAMERA CONTROL

The Webcam graphical user interface (GUI) allows you to control the camera's pan and tilt motion, change between wide and narrow fields of view, change the imaging mode from red/white-hot to gray/white-hot and set different levels of contrast.

To control the camera movement, use the arrow button  .

Please note the following:

- Pressing the single arrow ▶ and releasing the mouse button in less than one second lets the camera move one step (1/3 or ¼ of FOV).
- Pressing and holding the single arrow allows the camera to move at 1/10 FOV /second. Releasing the mouse button stops the movement.
- Pressing the double arrows ▶▶ produces the same results but at two times the speed (steps and speed).
- Double clicking on the symbol in the upper left portion of the GUI will make the camera turn in that direction.

NOTE: The Home position cannot be changed through the GUI. When you click on Home, the camera will return to the last saved position. Changes to the Home position must be made on site (on the vessel).

Image Mode Control – Click the Night button to toggle between red (night) and gray (daytime) modes.

Same image with different color modes - White/Hot Night (left) and Day (right) color modes

Image Contrast – Under Contrast Mode you have four preset options: Night Underway, Night Docking, Day, and Man Overboard. It is advisable that you find and select one that produces the best image for your needs for the current environmental conditions.

Black/White Hot – If you select White Hot, hot objects are displayed in white, cold objects in black, with the color gradient between them indicating relative temperatures between hot and cold. Selecting Black Hot reverses the image and hotter objects are now displayed in black.

Field of View (fov) Control – You can change between Wide and Narrow field of view (see figure below). The Focus function only applies to the Narrow field of view.

Focus Control – When the Narrow field of view is selected you can use the Near/Far/ buttons to manually focus the camera. Use the Far button to "pull back" on the focus function, and the Near button to focus in. Using the Near/Far buttons instead of just using the Auto focus button will speed up the focusing process.

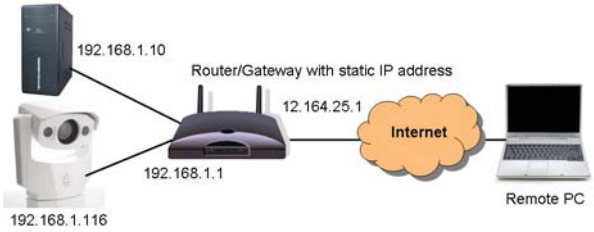
Full Screen Video – If you wish to view the video in full screen mode, double-click on the image. To exit the full screen mode, double-click on the image again.

NOTE: No icons are displayed on the MPEG video stream. Refer to the graphic to the left of the video for azimuth control, which indicates the direction the Voyager is pointing relative to the bow of the vessel.

REMOTE ACCESS

The webcam feature is designed to allow access to the camera remotely over the Internet. For example, the following diagram shows a typical scenario. The laptop in a remote location would be used to connect to the Voyager II over the Internet. It is assumed the Router/Gateway will perform Network Address Translation (NAT) and port forwarding. Therefore it is necessary to configure the following items on the Voyager II:

1. IP address on the local network (in this example, 192.168.1.116)
2. Default gateway (192.168.1.1)
3. Video devices such that video streams are sent to the external IP address (12.164.25.1)

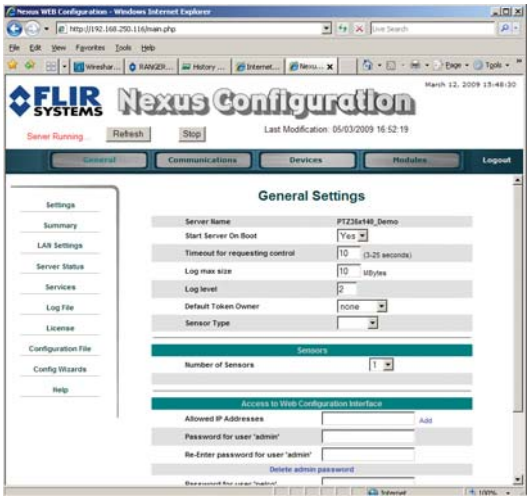


Note: Once the camera is configured for remote access from the remote PC through the Router/Gateway, it is not possible to access the webcam feature from the local PC (192.168.1.10 in the example above).

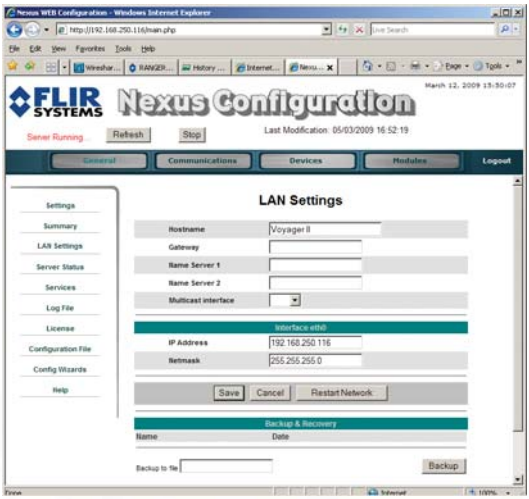
IP CONFIGURATION

To add the camera to the local network, it is necessary to log into the web configuration pages with the browser, and then change the camera IP address to match the local network. Point the web browser of the PC to the default IP address again by typing "192.168.250.116" in the location field. In the screen with the picture of the Voyager II, enter the User name "admin" and Password "indigo", and then click on the Login link. The **General Settings** screen will be displayed as shown below. Click on the LAN Settings tab on the left.

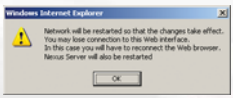
SECURITY WARNING: in order to protect against unauthorized access to your camera from other internet users, you must take steps to protect your connection. FLIR recommends that you set up a firewall on your router.



The LAN Settings screen will be displayed. Enter the Hostname, Gateway, IP Address, and Netmask that are appropriate for the local network. Then click Save.



A message will appear indicating the IP address has been changed and the browser will no longer be able to communicate with the camera.

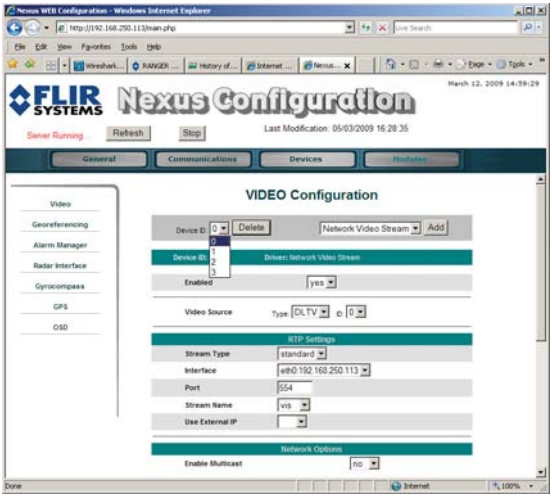


Now it is necessary to change the IP address of the PC back to its original address on the network. In this example, the PC address is set to 192.168.1.10. Then point the web browser at the Voyager II again and if necessary login again.

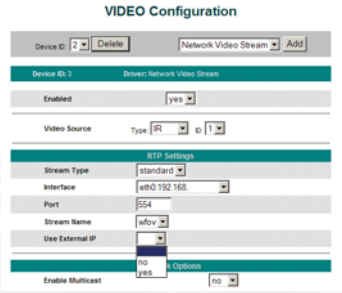
VIDEO DEVICE CONFIGURATION

Click on the Modules tab and the Video Configuration screen will appear. Device ID 2 is associated with the Wide FOV thermal video (stream name wfov) and Device ID 3 is associated with the Narrow FOV thermal video (stream name nfov). Both devices need to have an External IP Address configured.

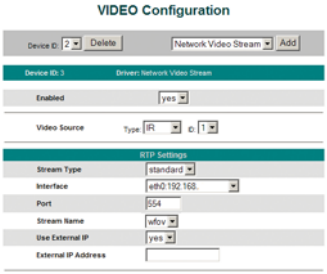
Select Device ID 2 from the pull down.



Click on the “Use External IP” pulldown and select “yes”.



When you select "yes" a new field, External IP Address, will appear on the page. Enter in the static IP address that the router/gateway uses to access the Internet. In this example, the external IP address is 12.164.25.1.



Once the external IP address is entered, scroll the page down and click on the Save button. Then repeat the same steps with Device ID 3.

Important: if Device ID 3 is selected prior to clicking the Save button, the configuration changes to Device ID 2 will be lost.

When done, reset the camera by turning it off and on, or Stop and Start the server by using the Stop/Start buttons at the top of the page. Either method will restart the server with the new settings in effect.

Note: Once the camera is configured for remote access from the remote PC through the Router/Gateway, it is not possible to access the webcam feature from the local PC (192.168.1.10 in the example above).

WEB BROWSER CONFIGURATION

Supported Browsers

The following browsers/versions are currently supported:

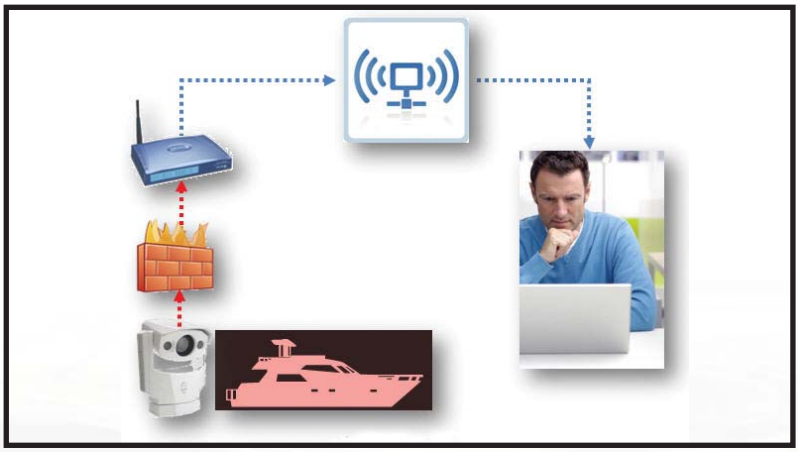
- **Microsoft Internet Explorer 7**
- **Safari 3.1.2**
- **Firefox 3.0.4**

Installing the VLC Player – Before you can start using the Voyager II camera through a remote connection you must download the VLC Video Player, which is the supported video player. If you are using Internet Explorer™ 6/7 you will be prompted to install the VLC Player the first time you log on to the remote site and the Voyager camera will download the software to your computer.

If you use the Firefox™ or Safari™ browser, you can download and install the necessary player yourself before you can use Voyager as a Webcam. You can download a copy of the player here:

http://download.videolan.org/pub/videolan/vlc/0.8.6f/

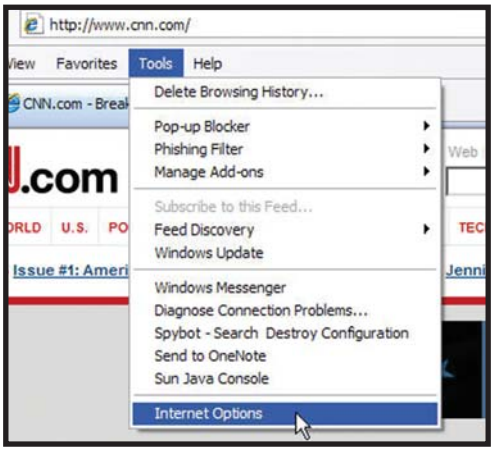
If you have problems finding or downloading the player, contact FLIR Technical Support.



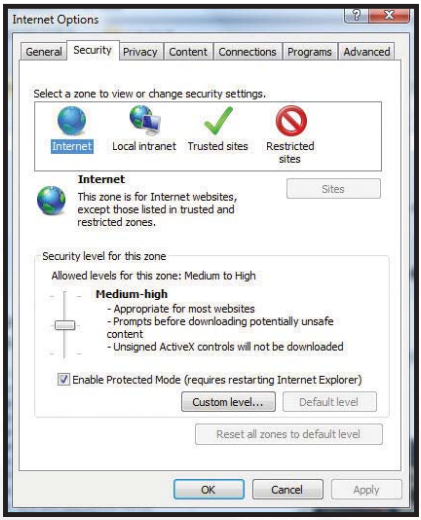
Voyager II working as a Webcam

Internet Explorer Users – You can download the VLC Player directly from the Voyager (the software is already installed in the camera). In order to be able to download the VLC Player you may need to change your Security settings in Internet Explorer. This is necessary only in order to download the software. Once you download the player you can reset your security settings. To change the security settings to allow the download of the player, follow these steps:

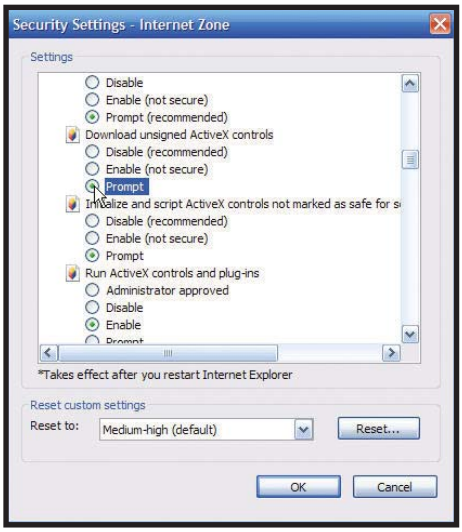
1 - In Internet Explorer, click on Tools and select Internet Options:



2 - In Internet Options, select Security Tab, then Custom Level:

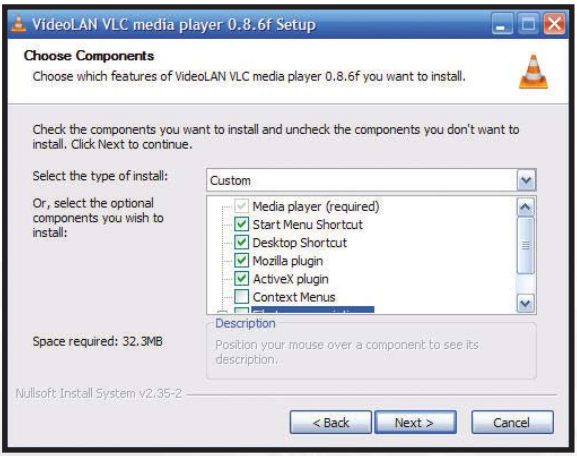


3 - Scroll down through the options until you find "Download Unsigned Active-X Controls", then change the setting from Disable to Prompt:



Click OK when done and exit all dialogue windows. You can now download and install the VLC Player.

Download and save the executable file to your computer, then click on the file to install the application. Please note that when asked to choose components you must make sure you select also the Mozilla plug-in:



TROUBLESHOOTING & CLEANING

TROUBLESHOOTING

CAUTION!

Do not open the camera body for any reason. Disassembly of the camera (including removal of the cover) can cause permanent damage and will void the warranty.

The Voyager is a simple, yet sophisticated device, built to provide years of trouble-free use. If you do run into problems with your Voyager, try these simple steps:

- If the camera will not produce an image, check the fuses in the Breakout Box first. Make sure that power to the Voyager is off, and remove the fuses one at a time, checking to see if they are still intact. If one of the fuses has blown, determine the cause of the blown fuse, fix the problem, and replace with one of the spare fuses supplied.
- Check the wiring at both the electrical panel and at the termination to the JCU. Ensure that the contacts are clean dry and free from corrosion. If maintenance on the wiring connection is required, have an authorized service representative make the appropriate repairs.
- If the camera still will not produce an image, check the video connection at the camera and at your display. If the connectors appear to be properly engaged but the camera still does not produce an image, have an authorized service representative make the appropriate repairs.

CLEANING

CAUTION!

Clean the camera window only with low-pressure fresh water and a soft cloth.

CAUTION!

Improper care of the camera window can cause damage to its anti-reflective coating, degrade the camera's performance, and void the camera warranty.

The camera housing has a durable marine coating. Rinse the camera housing with very low-pressure fresh water to keep it clean. If the front window of the camera gets water spots, wipe it with a clean lens cloth folded in fourths and dampened with fresh water.

FUNDAMENTALS OF INFRARED

INTRO TO INFRARED TECHNOLOGY

The Voyager detects differences in heat and displays them as black and white TV video. It may look like a black and white version of what your eyes see, but it's not. The Voyager sees heat, not light. The sooner you can understand and get comfortable with that difference, the more you will enjoy this incredible technology.

Why things look the way they do

The Voyager's thermal imager makes video images from differences in heat, not from the light you see every day. It senses the minute differences in heat between objects, and (in white-hot mode) displays the warmer objects as white (or lighter shades of gray), and colder objects as black (or darker shades of gray).

Everything you encounter in your day-to-day existence gives off heat – even ice! Chances are that the hotter something is, the easier it will be to see.

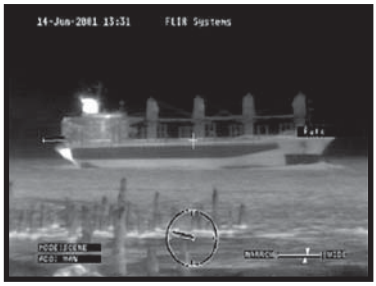
While most things give off their own heat, some things actually reflect the heat given off by other things. Water and polished metal, for example, aren't as hot as they appear when they reflect sunlight.

What's more, some things that are the same temperature (or close to it) look different because of their different surface textures.

IR energy doesn't go through glass efficiently, so Voyager won't let you see through glass.

Thermal imagers are passive – they only receive incoming energy. They don't "see through" anything. While you might think you are seeing through the hull of the vessel on the right to see the bulkheads and heat from the engine, you're not. These elements are actually changing the temperature of the hull itself, allowing you to see the bulkheads and the hot engine room.

As you experiment with your Voyager, you will begin to see a world of heat. Consider every object you view in terms of how it will look "thermally" as opposed to how it looks in the visible spectrum.



Weather

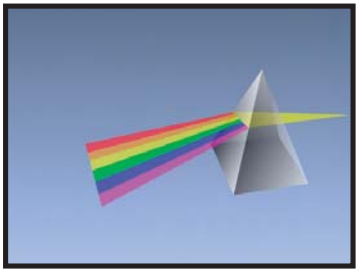
Environmental conditions, including time of day, humidity, and precipitation, will affect image quality and contrast. Fog, smog and rain will decrease the range at which you can detect a given target. After sunset, objects warmed by the sun during the day will radiate their stored heat for several hours. Early in the morning, many of these objects will appear cooler than their surroundings, so be sure to look for subtle temperature differences in the scene, not just hot (white) targets.

MORE ABOUT INFRARED

At first blush, new technologies can appear intimidating. Infrared cameras may seem imposing, but they are not so different from digital camcorders. In fact, you can get years of enjoyable, productive use out of your Voyager without knowing anything in this section. But, if you would like to learn more about thermal imaging – how it was discovered and developed – read on.

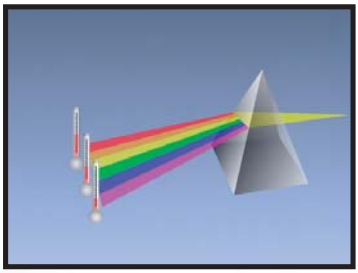
Infrared – the early years

The road to modern thermal imaging began way back in 1666, when Sir Isaac Newton used a prism to split white light into the colors of the rainbow. Today, we call this rainbow the "Visible Light Spectrum."

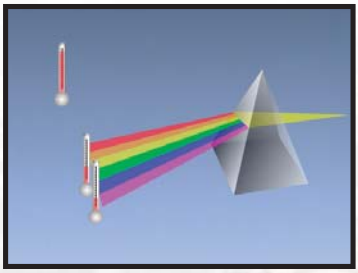


Newton's experiment proved that sunlight was not an indivisible whole, as was once thought, but was made of a range of subtly different light energies.

In 1800, Sir William Herschel took this discovery one step further, when he found that the different colors of the Visible Light Spectrum have different temperatures, which increase from the violet band of the spectrum to the red.



He did this by splitting sunlight with a prism and placing the darkened bulb of a thermometer in each color band. When he moved a thermometer past the red color band, Herschel found that the energy beyond visible red light was warmer than the red light itself. His name for this energy was "Calorific Rays." Today we call it "infrared radiation" or "thermal energy," and use the two terms interchangeably.



High school physics revisited

Infrared radiation combines with Gamma rays, X-rays, Ultra Violet, Visible Light, Microwaves and Radio Waves to form a range of energy called the Electromagnetic Spectrum.

These are not independent types of energy – in fact, the primary difference between each of these types of radiation is wavelength: Radio Waves have the longest wavelength and Gamma Rays have the shortest. Wavelengths are measured in micrometers, or "microns" (μ), which are equal to one millionth of a meter.

Infrared radiation wavelengths are longer than those of visible light. Visible light wavelengths range from 0.4μ to 0.75μ, while infrared is between 1μ and 15μ. Thermal imagers make pictures from either the 3-5μ range (called mid-wave IR [MWIR]), or the 8-12μ range (called long-wave IR [LWIR]).

Thermal images may look like black & white photographs, but the two types of images are actually quite different. Photographic cameras create images from reflected light energy, while infrared cameras create images from radiated thermal energy.

The amount of radiated thermal energy that reaches the Voyager's imager is a function of the viewed object's temperature and emissivity. This relationship between temperature and emissivity can be a complex one, but we'll sum it up with two basic rules:

1) The hotter an object gets, the more infrared energy it radiates. Even a small increase in temperature can result in a dramatic increase in the amount of radiated thermal energy.

2) At a given temperature, the amount of thermal energy radiated by an object depends on its emissivity. Emissivity is the measure of an object's efficiency at radiating thermal energy. For example, shiny metals are poor emitters. Instead of radiating their own thermal energy, they tend to reflect radiation from their surroundings.

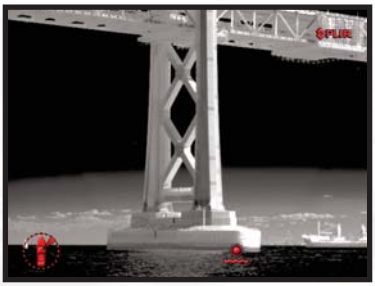
Infrared, from theory to practical application

Infrared imagers operate by detecting the relative intensities of thermal energy radiated from the surfaces of objects, and displaying these intensities in black and white video as shades of gray. They do not show a "heat picture." Even if an object is very hot, it may not display well if there is little or no temperature contrast between the object and its surroundings.

Thermal imagers primarily detect thermal energy radiated from an object's surface; thermal imagers can't "see through" much of anything, except some plastics and nylon materials.

As you look at the thermal images created with your Voyager, you will see multiple sources of thermal energy in addition to your main object of interest. When looking at a scene with a large number of heat sources, it can get confusing trying to sort it all out. Kirchhoff's Law is an easy way to account for the different sources of thermal radiation you see in your images. Kirchhoff says that all of the thermal radiation in an image has been Emitted (given off by an object), Transmitted (passed through an object), or Reflected (bounced off an object).

Most of the strong energy sources you will see in a given scene are from "emitted" energy. That is, they are giving off heat energy. Examples of strong emitters of thermal energy include people and boat engines.



Thermal energy doesn't pass through much, but it does "transmit" through some plastics. When a material is not transparent to infrared radiation, it is said to be "opaque." Most commonly viewed materials are opaque to infrared radiation.

Materials that mirror the infrared signatures around them are "reflective." Everything is reflective to one degree or another, but the most highly reflective objects are those made of polished, unpainted metal. Painted metals, glass, and even wood can display greater or lesser degrees of reflectivity, but this becomes dependent upon myriad factors like their surface coatings, textures, and the angles from which they are viewed. Reflections can appear hotter or colder than they really are, based on what they are reflecting. Sun reflecting off of polished chrome looks quite bright, and a common mistake is to think that this section of chrome has suddenly become very hot. It hasn't, it is just reflecting energy from the sun. Look also at the two images on the previous page, and note the reflections of thermal energy from the bridge and boat off the water, which can readily reflect thermal energy.

Another reason to care about the weather

The time of day and weather conditions in which you use your Voyager can have a significant influence on how objects look on the screen. Remember that thermal imagers detect and display differences in infrared radiation. If an object and its background do not display any appreciable temperature difference, that object will be very difficult to detect. Therefore, the time of day during which your Voyager is used can have a direct impact on your ability to detect and recognize objects.

When things are exposed to the sun, they absorb infrared radiation. As the duration of this exposure increases throughout the day, thermal contrast between targets decreases.

When the sun begins to set, objects begin to cool. In doing so they radiate some of this stored thermal energy back into the atmosphere, and a certain degree of thermal contrast is restored. This increase in contrast continues until the sun comes up the following morning. This daily sequence of heating and cooling is called the "Diurnal Cycle."

Atmospheric conditions can limit the range and imaging performance of your Voyager. Under ideal conditions, most of the infrared energy radiated from an object gets through the atmosphere and to the imager.

Under typical conditions however, atmospheric moisture and dust scatter can absorb some of the radiated energy before it reaches the imager. The effect of this is to weaken the overall thermal signal and shorten the range at which you can detect it.

The weather can impact more than just the range at which the Voyager can detect a specific object – it can also affect an entire scene's thermal contrast and affect overall system performance.

Cloud cover affects the diurnal cycle in two ways:

First, cloud cover decreases the amount of solar radiation allowed to strike the earth's surface, keeping days cooler and nights warmer.

Second, clouds form a layer of insulation over the earth that prevents heat from being radiated back into space at night.

Like clouds, humidity tends to reduce contrast and wash out the effects of the diurnal cycle. While humidity doesn't block out solar radiation during the day, it does tend to keep nights warmer.

Rain acts differently because water tends to cool the surfaces it touches. Remember that thermal imagers only detect differences in thermal energy radiated from an object's surface; therefore, rain can markedly reduce a scene's contrast. While rain reduces contrast between objects with no heat source, it will allow objects with a heat source (like, people, animals, running vehicles, some structures) to show up with even more contrast to their now-cooler surroundings.

Conclusion

If you see something through your Voyager that looks suspicious, it is best to play it safe and steer clear of it. You will likely run into situations where even the Voyager will not provide a perfect image of what is ahead of you. But in most conditions it should serve you well as a valuable addition to your navigation tools. !

APPENDIX
PARTS LIST AND ACCESSORIES

SYSTEM OVERVIEW

APPENDIX

Parts List

The Voyager includes the following thermal imaging components:

If the components you have are different from those enumerated in this parts list, please call us immediately at 888.747.3547.

Voyager		FLIR Part Number
Camera Body		432-0002-01-00 432-0002-01-00S 432-0002-02-00 432-0002-02-00S
Bulkhead Box		500-0348-00
Joystick Control Unit (JCU)		500-0353-00
Camera Cable	50' or 100'	308-0149-50 or 308-0149-100
JCU Cable	100'	308-0139-00
Operator's Manual		432-0002-00-11

Accessories

Dual Control Station Accessory Kit JCU, 100' cable (one end terminated)	500-0353-00
JCU Extension Cable terminated both ends	308-0139-101

Voyager II™

SYSTEM OVERVIEW

Size	15” x 23”
Weight	45 lb.
Azimuth	360° Continuous
Elevation	+/-90°
Slew Rate	Variable to 120°/sec.

Thermal Imaging Performance

Sensor Type	2 Microbolometer Cameras
Wide FOV	20° x 15° (35mm)
Narrow FOV Imager	5° x 3.75° (140mm)
Spectral Range	7.5 to 13.5 µm

Daylight Imaging Performance

Sensor Type	1/4” Super HAD
Wide FOV Limit	42° horiz. @ F1.6
Narrow FOV Limit	1.6° horiz. @ F3.8

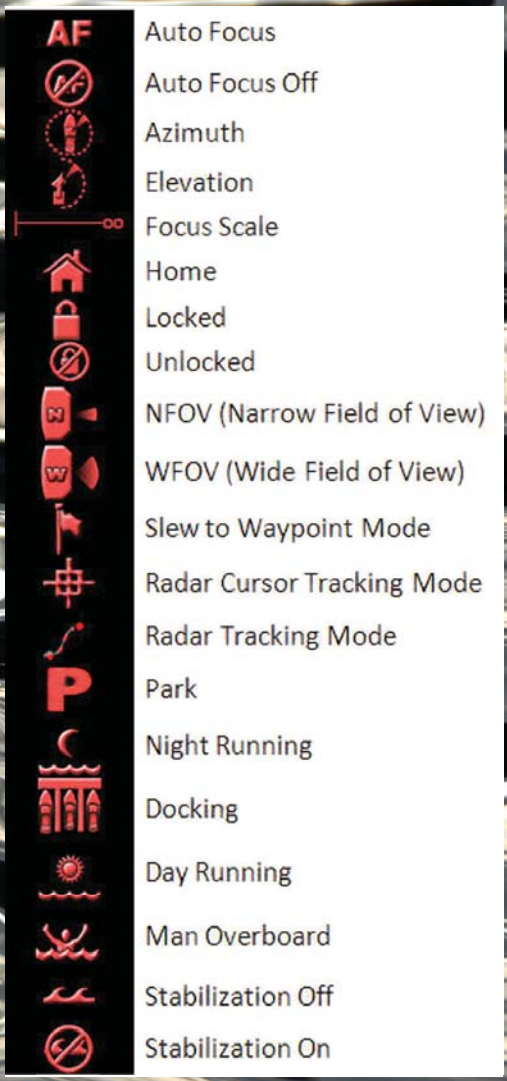
System Specifications

Pan/Tilt Coverage	360° Az./ +/-90° El.
Video output	NTSC or PAL
Power Requirements	24VDC

Environmental

Operating Temp. Range	-28°C to 55°C
Non-Operating Temp. Range	-50°C to 85°C
Vibration	Per MIL-STD-810

LIST OF ICONS



FLIR Systems, Inc.
CVS World Headquarters
FLIR Systems, Inc.
70 Castilian Dr.
Goleta, CA 93117
USA
PH: + 1 877 773 3547
PH: + 1 805 964 9797
FX: + 1 805 685 2711
sales@flir.com

EUROPE
CVS Eurasian Headquarters
FLIR Systems CVS BV
Charles Petitweg 21
4847 NW Teteringen - Breda
Netherlands
PH: + 31 (0) 765 79 41 94
FX: + 31 (0) 765 79 41 99
flir@flir.com

FLIR Systems, Inc.
Corporate Headquarters
FLIR Systems, Inc.
27700A SW Parkway Ave.
Wilsonville, OR 97070
USA
PH: + 1 877 773 3547
FX: + 1 503 498 3904
sales@flir.com